ROLE OF PLANT SURFACE LIPIDS IN THE PROCESS OF PHYTOREMEDIATION

Oksana Berzenina[1], **Nataliia Shtemenko**[2] **and Oleksandr Shtemenko**[1]
[1]*Ukrainian State University of Chemical Technology, Dnipro, Ukraine,*
[2]*National Technical University "Dnipro Polytechnic", Dnipro, Ukraine*
berzenina@gmail.com

Surface lipids (SL) of plants (epicuticular waxes) are complex mixture of highly hydrophobic substances which have most important functions of control of water status; anti-adhesive, self-cleaning properties; protection against radiation, pathogens and chemicals penetration. Also, as plant SL play pivotal physiological and ecological roles, it might be advantageous to adapt their composition and properties to environmental stresses, for example, for high concentrations of some exogeneous chemicals. Some water plants, representatives of *Helophytes* are used in remediation in constructed wetlands and are shown to have specific content of SL. Helophytes (synonyms – emergent water plants, marsh plants, etc.) are used for treatment of contaminated waters and are good absorbers of aromatics.

The aim of the investigation was to analyze if SL of plants really were changing under influence of pollutants and to determine the scale and directions of these changes. SL were obtained from leaves of healthy and good developed plants *Phragmites australis* (Cav.) Trin ex Steud., *Typha latifolia* L. grown in Dniepr botanical garden (control) and in the sewage ponds of Dniep varnish-dye plant (exposed) with complex contamination with organics and heavy metal salts. Spectral (Fourier transform infrared, FTIR), molecular-dynamic characteristics (thermogravimetric analysis coupling with FTIR in air and in nitrogen atmosphere, TG-FTIR) and content of components (GC-MS) were considered. FTIR-spectra of SL of control and exposed plants had some differences in the „finger-print" area. Thermogramms (TG and DTG) and evolutional profiles of water, carbon dioxide and carbon monooxide had many differences in control and expposed plants that confirms their different molecular-dynamic characteristics, dependent on content and associative abilities. We have found more total quantity of SL in exposed plants than in control. It possibly means that the influence of pollutants activates biosynthesis of SL. Dominating fatty acids in SL of both control species were fatty acids of C_{16} and C_{18} groups; among hydrocarbons prevailed odd numbered C_{25} - C_{29} components that all are typical for water plants. Changes in SL composition took place under influence of contaminants: in both species the content of fatty acids increased in SL of exposed plants in comparison with control; especially significant was increasing of unsaturated fatty acids. Process of adaptation to toxicants in SL of both investigated species differed in influence on biosynthesis of long-chained compounds: in *Phragmites australis* we have found inhibition of elongation, resulting in a decrease of long-chained fatty acids and hydrocarbons; in *Typha latifolia* there was a strong increase of the content of fatty acids with chains more than C_{20}, that gave possibility to explain TG-FTIR curves of 2 exposed sample. Some differences between control and exposed plants were found in minor components of SL. In the case of the investigated plants the formation of SL in the process of adaptation to xenobiotic exposure may require the appearance of such protective molecules also.

We may conclude that contaminants influenced on biosynthesis of SL components; these changes concern processes of elongation and desaturation of SL components; the response to contamination is specific for each specie. Such influence of contaminants to our mind may occur in two ways: as proper enzymes or enzymatic systems inhibition (promotion) or as direct including of metabolites derived from toxicants of organic nature (for example pyruvate) to SL biosynthesis. These data support the idea that there may be found species among emergent or terrestrial plants with flexible system of SL formation and they could be good objects for monitoring investigations.

Key words: Surface lipids, Constructed wetlands, Helophytes, Fatty acids